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(54) **Title of the Invention:** Tire-Drive Type Crawler Belt Device

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(and two other people)

2. Claims

1. In a tire-drive type crawler belt device comprising a plurality of wheels fitted with tires made from a flexible material, and a crawler belt made from a flexible material mounted on this plurality of wheel tires, and provided at the inner side section of the crawler belt with a side-guide that faces at least a portion of the shoulder of the tire, a tire-drive type crawler belt device characterized in that: a portion of the shoulder forms a rectilinear taper-face from a tread section to a sidewall section; an inner side section of the side-guide of the crawler belt forms a taper-face corresponding to the aforementioned taper-face; and a friction reducing member is interposed between the two taper-faces.

2. The tire-drive type crawler belt recited in claim 1 characterized in that said friction reducing member is any of: Teflon sheeting, Teflon-added rubber, cotton-chip filler containing rubber, resin spike pins, or resin netting.

3. Detailed Description of the Invention

Field of Industrial Application

The present invention relates to a tire-drive type crawler device, wherein a crawler belt is mounted on a plurality of wheel tires.

Prior Art

A vehicle for driving on ungroomed terrain equipped with a tire-drive type crawler belt device, wherein a rubber crawler belt is mounted on a plurality of wheel tires, is known from Japanese Unexamined Utility Model JP-52-28258-U; on the inner side section of this crawler belt, a side-guide is provided, facing the side of the tire.

FIG. 19 shows a sectional view of the key elements thereof, wherein 100 is a pneumatic rubber tire, 101 is a rubber crawler belt and 102 is a side-guide; FIG. 20 shows a sectional view of the ordinary bias tire 100 alone.

Problems to Be Solved by the Invention

With conventional tire-drive type crawler belt devices, as shown in FIG. 19, the local surface pressure between the side of the tire 100 and the side-guide 102 of the crawler belt 101 becomes high in some places, which increases frictional resistance.

Accordingly, when a side-force is received during turning or the like, or when driving over a gap such as a curb, the tire 100 contacts the side-guide 102 from above, as shown in FIG. 21; and as shown in FIG. 22 and FIG. 23, elastic deformation occurs, in which the side-guide 102 is embedded in the sidewall of the tire 100, so that the tire 100 rides up on the side-guide 102, as shown in FIG. 24, and the tire 100 can easily separate from the crawler belt 101.

Here, an object of the present invention is to provide a tire-drive type crawler belt device capable of preventing the tire from riding up on the side-guide of the crawler belt while improving the slip between the tire and the side-guide by lowering the friction therebetween, so as to effectively prevent the tire from separating from the crawler belt by preventing the tire from riding up.

Means for Solving the Problems

In order to achieve the aforementioned object, in a tire-drive type crawler belt device comprising a plurality of wheels fitted with tires made from a flexible material, and a crawler belt made from a flexible material mounted on this plurality of wheel tires, and provided at the inner side section of the crawler belt with a side-guide that faces at least a portion of the shoulder of the tire, the present invention is characterized in that: a portion of the shoulder forms a rectilinear taper-face from a tread section to a sidewall section; an inner side section of the side-guide of the crawler belt forms a taper-face corresponding to the aforementioned taper-face; and a friction reducing member is interposed between the two taper-faces.

More specifically, the friction reducing member is any of: Teflon sheeting, Teflon-added rubber, cotton-chip filler containing rubber, resin spike pins, or resin netting.

Operation

The shoulder of the tire is given a rectilinear taper-face from the tread section to the sidewall section, and a taper-face corresponding thereto is provided on the inner side of the side-guide of the crawler belt; therefore, when a side-force is received during turning or the like, or when driving over a gap such as a curb, the contact [face] between the two taper-faces functions as a guide face that keeps the tire within the crawler belt, so as to prevent the tire from riding up on the side-guide.

Next, because a friction reducing member, such as Teflon sheeting, Teflon-added rubber, cotton chip filler containing rubber, resin spike pins, resin netting, or the like, is interposed between the two taper-faces, the friction coefficient between the two taper-faces is reduced, and these can easily slip.

Embodiments

Hereinafter embodiments are described with reference to the attached drawings.

In FIG. 1 to FIG. 3, which illustrate the configuration of a light-truck type, six-wheeled crawler belt vehicle, which serves as an example of application of the present invention, 1 is a vehicle body, 11 is a front wheel, 13 is a rear wheel, 15 is an idler, and 17 is a crawler belt.

The vehicle body 1 comprises a cab 2 and a cargo bed 3; as shown in the figure, an idler 15 is disposed between the front wheel 11 and the rear wheel 13; and rubber pneumatic tires 12, 14 and 16 are mounted on each of the wheels. Next, this comprises a control device 5 for transmitting control force from a steering wheel 4 within the cab 2 to the pair of front wheels 11, 11 on the left and the right. The control device 5 comprises a steering shaft 6, a gearbox 7, steering arms 8, tie rods 9, and the like, and the tie rods 9 are connected to knuckles 21, on which the front wheels 11 are mounted. Furthermore, the front wheels 11 are provided with a front suspension 22 for supporting these in free suspension with respect to the main vehicle body 1; which is to say that, between the bottom of the cab 2 of the main vehicle body 1 and the front wheel knuckles 21, are interposed suspension components such as a radius rod 23 and a hydraulic damper 24.

Meanwhile, an engine 25 is installed beneath the cargo bed 3 of the main vehicle body 1; the rear wheels 13 and the idlers 15 being disposed on both the right and the left side of this engine 25. A rear-wheel drive device 26 transmits the rotary drive force from a transmission that is

united with this engine 25 to the pair of rear wheels 13, 13 on the right and the left. The rear-wheel drive device 26 comprises a differential drive device 27 at the rear of the engine 25 and a rear-wheel drive shaft 28; the rear-wheel drive shaft 28 is connected to a rear wheel axle 29 which is supported at the back of a swing beam 31.

Next, the rear wheel 13 and the idler 15 therebefore, are mounted on the swing beam 31, and a rear suspension 32 is provided to support this swing beam 31 in free suspension with respect to the main vehicle body 1. That is to say, the center of the swing beam 31 is swingably joined to a leaf spring 33, which is installed beneath the cargo bed 3 of the main vehicle body 1, while hydraulic dampers 34 and 35 are mounted between the front and the back of the swing beam 31 and the bottom of the cargo bed 3; furthermore, between the rear portions of the left and right swing beams 31, 31 is mounted a torsion-free axle beam 36. In the drawing, 36a is a torque canceling part at the center of the axle beam 36; 37 is a rubber stopper at the center of the leaf spring 33; and 38 is a shackle at the rear end of the leaf spring 33.

Furthermore, a rubber crawler belt 17 is mounted on the rear-wheel tire 14 and the idler tire 16; and a multiplicity of inwardly protruding garters 19 are provided on both sides of the tread section 18 of this crawler belt 17. Next, an eccentric hub carrier 41 is provided at the front of the swing beam 31; and an idler axle 39 is supported on this hub carrier 41. Tensioning adjustment of the crawler belt 17 can be performed by way of eccentric rotation of this hub carrier 41 that supports the idler axle 39. The crawler belts 17, 17 described above are accommodated within the transverse dimensions of the vehicle body 1.

Moreover, a front-wheel drive device 42 is constituted so as to transmit rotational drive force, from the transmission that is united with the engine 25, to the pair of front-wheels 11, 11 on the left and the right. The front-wheel drive device 42 comprises a transmission shaft 43, which extends forward from the engine 25, a differential drive device 44 and front-wheel drive shafts 45, 45; the front-wheel drive shafts 45 are coupled with the front-wheel axles 46, which are supported by knuckles 21. In the drawing, 47 is a fuel tank, 48 is a battery, and 49 is a muffler.

The six wheeled crawler belt vehicle described above has excellent driving characteristics, not only on ordinary roads, as is a matter of course, but on light traction soil such as farm fields, and ungroomed terrain such as sand, snow or gravel, as a result of the ground-contact drive force of the left and right crawler belts 17, 17 and the ground-contact drive force of the front-wheel tires 12, 12. Next, because the crawler belts 17 are accommodated within the transverse dimensions of the vehicle body 1, the vehicle can qualify as a compact light vehicle, because the total width of the vehicle is not increased, as the crawler belt 17 does not protrude beyond the width of the vehicle body 1; the [vehicle] can drive on public roads at relatively fast speeds in the manner of an ordinary car; in addition to which, it can be used as a transport vehicle for materials such as farm equipment and fertilizer, in particular when driving on farm fields. Furthermore, it is excellent in terms of rider comfort because, in addition to the front wheels 11 having independent suspension, the rear wheels 13 and the idlers 15, which are mounted in the crawler belt 17, also have independent suspension.

With respect to the foregoing, an enlarged side view of the tire-drive type crawler belt device of the present invention is shown in FIG. 4; and the basic relationship between the rear-wheel tires 14, the idler tires 16 and the crawler belt 17 when driving straight forward are shown in the sectional view in FIG. 5.

In other words, as shown in FIG. 6, the shape of the shoulder sections which extend from the tread section 51 of both tires 14 and 16 towards the sidewall sections 52, 52 is such that rectilinear taper-faces 53 and 53 are formed, with the tread section 51 at the narrow end thereof. As shown in the drawing, these two taper-faces 53, 53 protrude outward beyond the sidewall sections 52, 52.

Next, the shapes of the inner sides of the garters 19, 19, which constitute the side-guides on both sides of the tread section 18 of the crawler belt 17, form taper-faces 54, 54, corresponding to the tire taper-faces 53, 53 of the tire, as shown in FIG. 5. Moreover, the tops of both the taper-faces 54, 54 of the garters form curved faces 55, 55 that continue into the outer side section.

Here, in the example shown in the drawing, a uniform extended portion 18a is formed at the outer side of the tread section 18 of the crawler belt; an unbroken metal rod is embedded in the tread section 18, which includes this extended portion 18a, in the transverse direction. By employing this transversally unbroken metal rod, when for example driving over a curb or the like, the tread section 18 of the crawler belt is prevented from bending. Furthermore, a metal

rod is also embedded in the vertical direction in the garters 19, and is unified with the aforementioned metal rod.

Next, the action between the tire taper-face 53 and the garter taper-face 54, when a side-force is received during turning or the like, or when driving over a gap such as a curb, is described.

When a side-force is received during turning or the like, or when driving over a gap such as a curb, as shown in FIG. 7, which illustrates a sectional view according to the arrow [*sic*] O-A in FIG. 4, a relative lateral displacement occurs between the crawler belt 17 and the tires 14 and 16; [but] the rotation causes the tire taper-face 53 to be guided downwards, in contact with the garter taper-face 54, so that the tires 14 and 16 are kept between the garters 19,19 on the two sides of the crawler belt 17, as shown in FIG. 8, which illustrates a sectional view according to the arrow [*sic*] O-B in FIG. 4.

Accordingly, [the device] is excellent in terms of a means for avoiding separation of the tires 14 and 16 from the crawler belt 17.

Furthermore, the top section of the garter taper-face 54 continues to the outer side section as a curve 55, whereby it is possible to eliminate catching when an edge of the tire tread section 51 rides up, so that the garter taper-face 54 can function to guide the tire taper-face 53.

Next, the tire taper-face 53 protrudes beyond the sidewall section 52, which is to say that the sidewall section 52 has a shape that is recessed with respect to the tire taper-face 53, whereby it is possible to avoid embedding the garter 19 in the sidewall section 52, when the tires 14 and 16 are laterally deformed, as happened in the past.

Next, the construction example shown in FIG. 9 is described.

In this example, in addition to a construction similar to that described above, the outer side garters 19 are greatly extended in the upward direction, the taper-face 54 being provided on the inner side section of this upwardly extended section 19a, and the curve 55 being provided at the top thereof.

Consequently, the tire taper-face 53 is restrained by the high garter taper-face 54, in the manner shown in FIG. 10, which illustrates outward lateral displacement.

In the present invention, with the basic relationship between the tires 14 and 16 and the crawler belt 17 as described above, a friction reducing member is interposed between the tire taper-face 53 and the garter taper-face 54.

FIG. 11 illustrates a first mode of embodiment wherein Teflon sheets 56, 56, serving as friction reducing members that have low friction coefficients, are bonded to the tire shoulder by way of vulcanization, whereby the surfaces of the Teflon sheets 56, 56, serve as the tire taper-faces 53, 53.

FIG. 12 illustrates a second mode of embodiment wherein the surface layer of the tire shoulder is formed by cotton chip filler containing rubber [members] 57, 57, wherein cotton chip has been mixed into the rubber, which serve as friction reducing members; and the surfaces of these cotton chip filler containing rubber [members] 57, 57 serve as the tire taper-faces 53 and 53.

Teflon-added rubber 57, wherein Teflon particles are mixed into the rubber, can also be used as a rubber [member] that has been hardened in this manner.

FIG. 13 illustrates a third mode of embodiment wherein a multiplicity of rod-shaped resin spike pins 58..., 58... are embedded in the tire taper-faces 53, 53 as the friction reducing members.

Furthermore, FIG. 14 illustrates a fourth mode of embodiment wherein a multiplicity of rivet-shaped resin spike pins 59..., 59... are embedded in the tire taper-faces 53, 53.

Next, FIG. 15 illustrates a fifth mode of embodiment wherein a resin net 61 is mounted on the tires 14, 16 as a friction reducing member.

In other words, the tire taper-faces 53, 53 and the tire tread section 51 are covered by a fine-mesh resin net 61, as shown in FIG. 16 and FIG. 17; hooks 66..., which are provided on a spring ring 65 engage with one of the cables 64, 64, which are provided at both edges of the resin net 61. In the drawing, 62 is a tread net section and 63 is a taper-face net section; and windows 62a... corresponding to tire blocks 51a... are formed in the tread net section 62.

By providing a friction reducing member 56, 57, 58, 59 or 61 on the tire taper-face 53, it is possible to facilitate slip by reducing the friction coefficient when in contact with the garter

taper-face 54.

Accordingly, it is possible to prevent the tires 14, 16 from riding up on the garters 19.

In the various embodiments as described above, a friction reducing member is provided on the tire taper-face 53, but the friction reducing member may be provided on the garter taper-face 54, or friction reducing members may be provided on both of the taper-faces 53 and 54; furthermore, other suitable materials and configurations may be used for the friction reducing member.

Moreover, the present invention may, as a matter of course, be used between garter taper-faces 54, 54 and tire taper-faces 53, 53, between double tires as shown in FIG. 11 [*sic*].

Note that, in the embodiments, the present invention was applied to a light-truck type, six-wheeled crawler belt vehicle, but the present invention may also be applied to crawler belt vehicles that are based on light vehicles such as single-body vehicles and other types. Furthermore, the positions of the idler and the rear-wheel may be reversed. In addition, flexible materials other than rubber may be used as the material for the crawler belt and the tire, and the tires may be other than pneumatic tires.

Effects of the Invention

By virtue of the present invention as described above, because the tire-drive type crawler belt device is such that a rectilinear taper-face is formed at the tire shoulder, from the tread section to the sidewall section, and a taper-face corresponding thereto is formed at the inner side section of the side-guide of the crawler belt, while a friction reducing member, such as Teflon sheeting, Teflon-added rubber, cotton chip filler containing rubber, resin spike pins, or resin netting, is interposed between the two taper-faces, when a side-force is received during turning or the like, or when driving over a gap such as a curb, [these members] function as a guide, whereby contact between the two taper-faces keeps the tire within the crawler belt; thus the tendency of the tire to ride up on the side-guide is prevented; and in particular because of the interposed friction reducing member, the friction coefficient between the two taper-faces is reduced, whereby slip is facilitated; accordingly it is possible to effectively prevent the tire from separating from the crawler belt.

4. Brief Description of the Drawings

FIG. 1 is a schematic side view illustrating a six wheeled crawler belt vehicle, which serves as an example of application of the present invention; FIG. 2 is a side-view illustrating [components] thereof, such as the drive device and the suspension; FIG. 3 is a plane view of the same; FIG. 4 is an enlarged side view of the tire-drive type crawler belt according to the present invention; FIG. 5 is a sectional side view of the key elements, showing the basic relationship between the tire and the crawler belt therein; FIG. 6 is a sectional view of the same tire alone; FIG. 7 and FIG. 8 are sectional views according to the arrow [*sic*] O-A and the arrow [*sic*] O-B in FIG. 4 when turning or the like; FIG. 9 is a sectional view of key elements, showing an example of a construction wherein a side-guide section is raised; FIG. 10 is likewise a sectional view of the same during turning or the like; FIG. 11 through FIG. 15 are sectional views of tires alone, showing various embodiments wherein friction reducing members according to the present invention have been provided on the sides of the tires; FIG. 16 and FIG. 17 are a side view and a bottom view, respectively, according to the direction of the arrow C and the arrow D in FIG. 15; FIG. 18 is a sectional view showing the basic relationship with the crawler belt in an example of double tires; in FIG. 19 onwards are shown conventional examples, and FIG. 19 is a sectional view of key elements, showing the relationship between a conventional tire and crawler belt; FIG. 20 is a sectional view of a tire alone; FIGS. 21 and 22 are sectional views of key elements, serving to describe the cause of tires riding up; FIG. 23 is a sectional view according to the arrow [*sic*] E-E in FIG. 22; and FIG. 24 is a sectional view of key elements, showing a tire riding up.

Note that, in the figures, 13, 15 are wheels, 14, 16 are tires, 17 is a crawler belt; 19 is a garter (side-guide section); 51 is a tire tread section; 52 is a tire sidewall section; 53 is a tire taper-face (shoulder section); 54 is a garter taper-face; and 56, 57, 58, 59 and 61 are friction reducing members.

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Agent, Patent Attorney; SHIMODA, Yoichiro
Ibid., Patent Attorney; OHASHI, Kunihiko
Ibid., Patent Attorney; KOYAMA, Yuu

FIG. 1

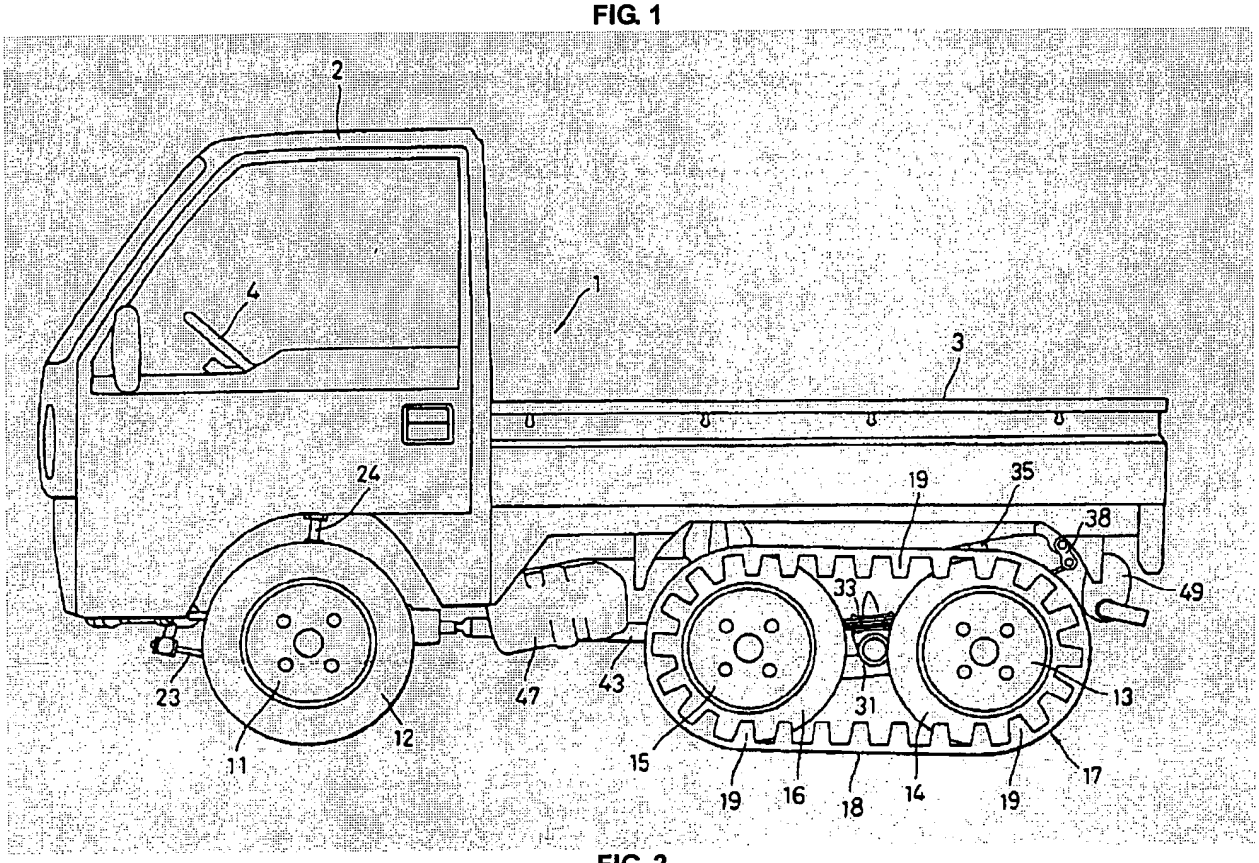
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FIG. 2

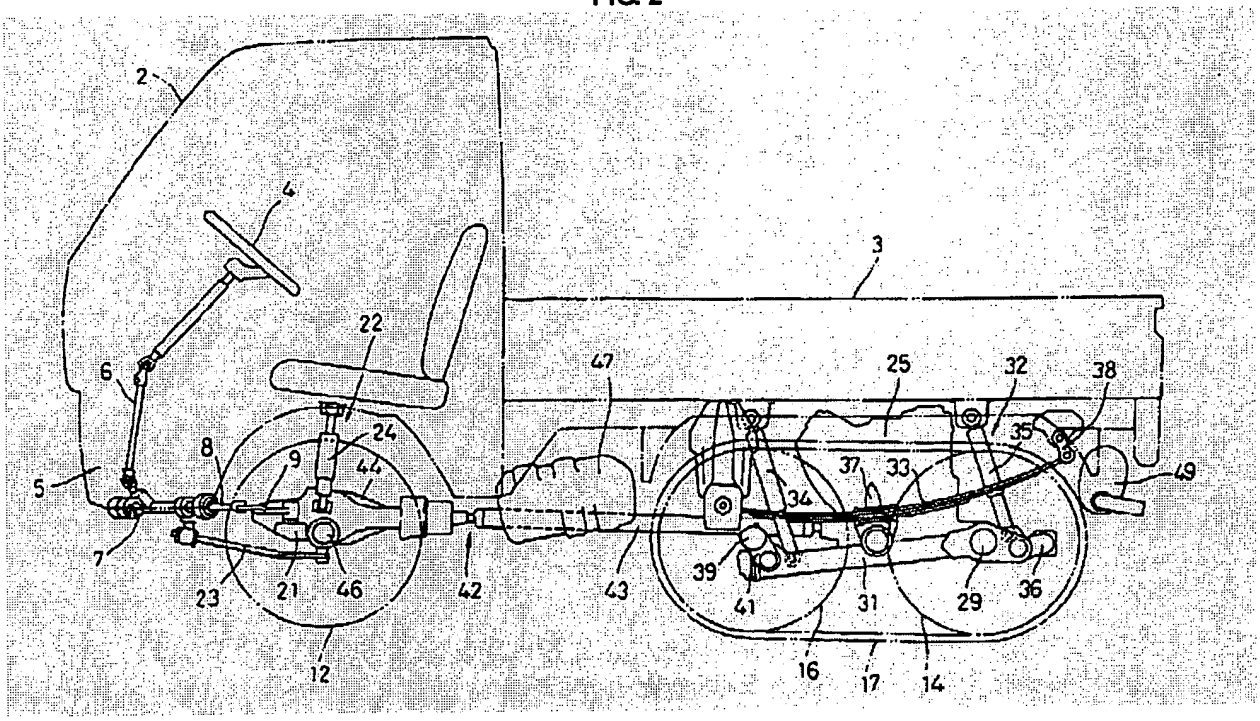
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FIG. 3

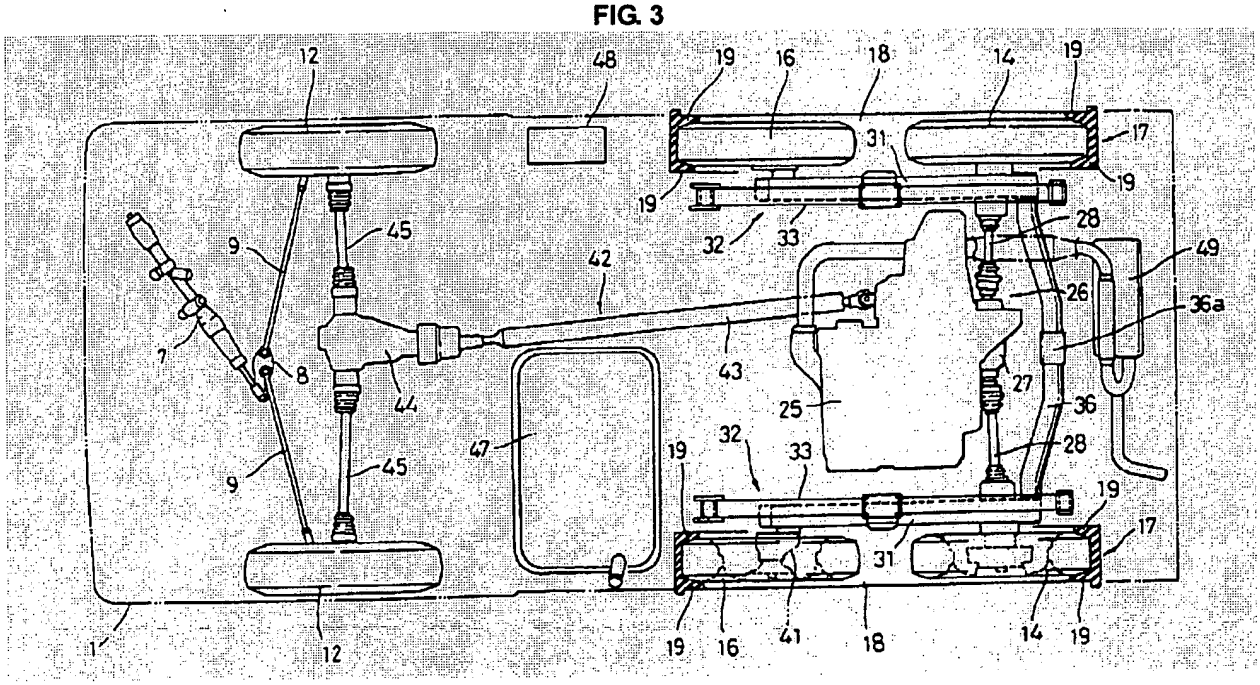

FIG. 4

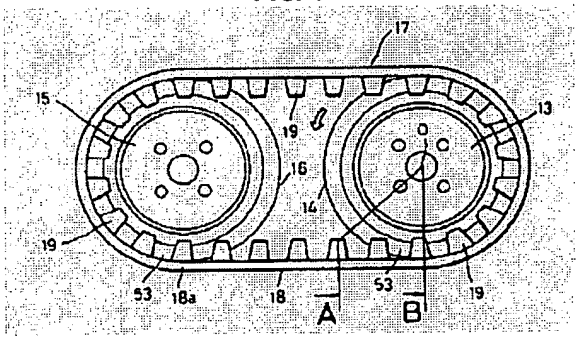

FIG. 10

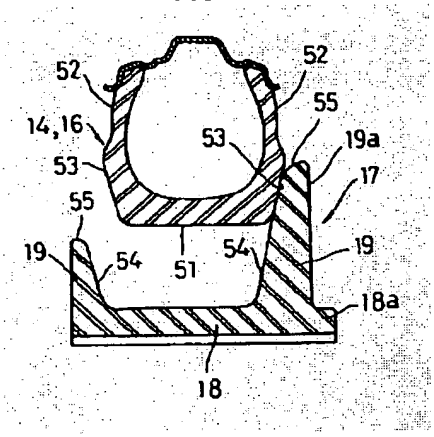

FIG. 5

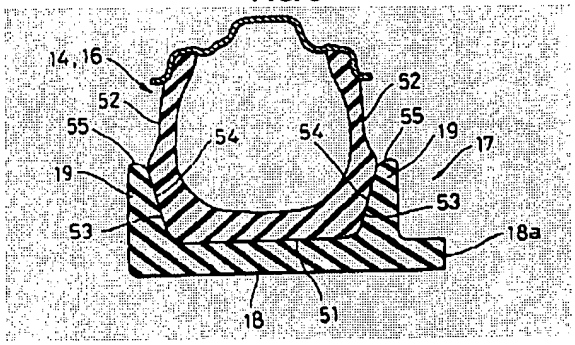

FIG. 9

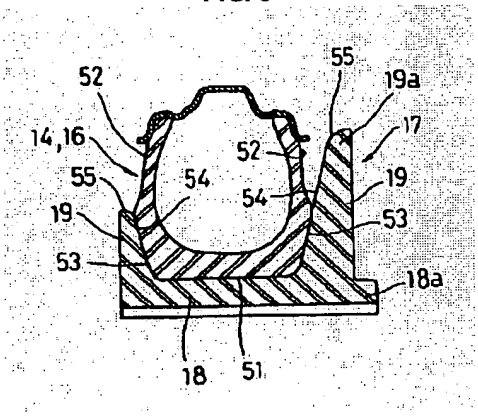

FIG. 6

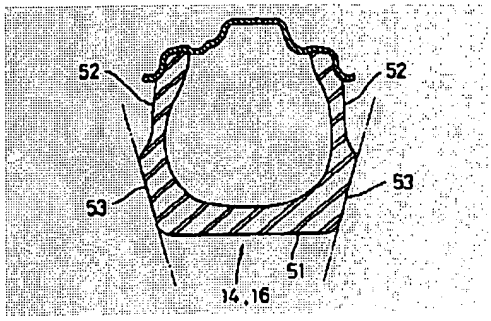

FIG. 7

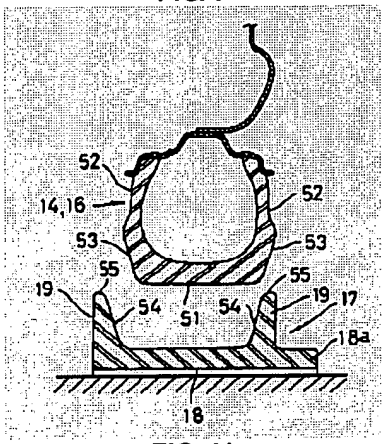

FIG. 8

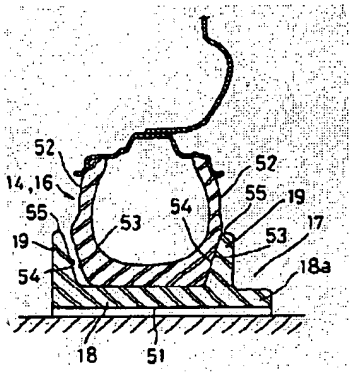

FIG. 11

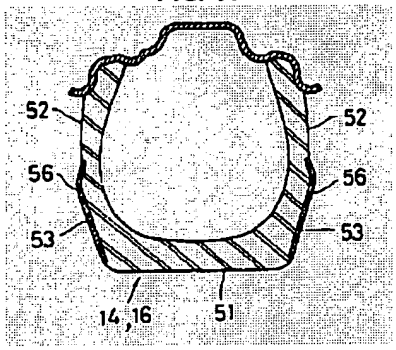

FIG. 12

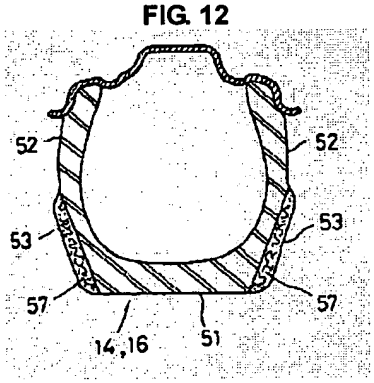

FIG. 13

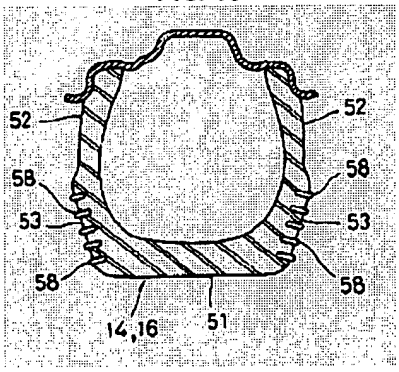

FIG. 14

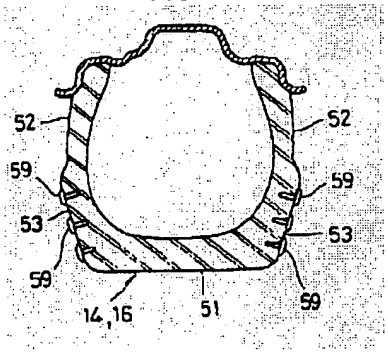

FIG. 15

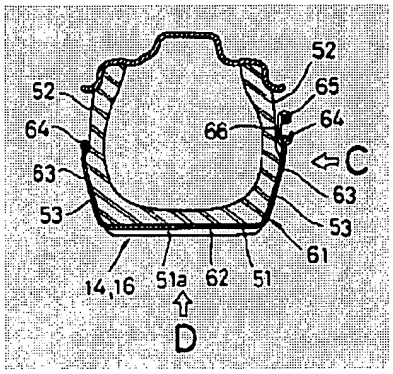

FIG. 16

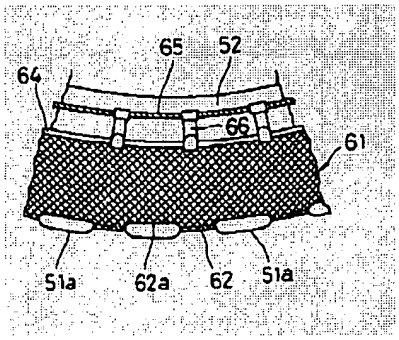

FIG. 17

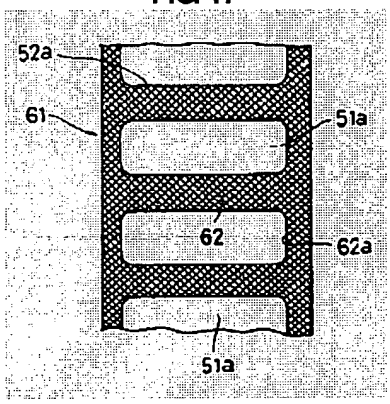

FIG. 18

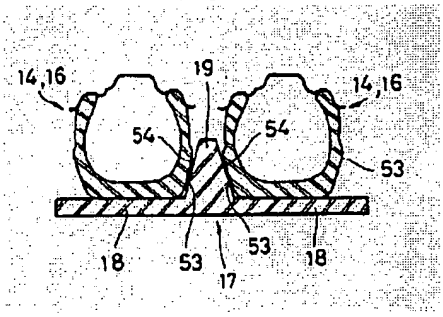

FIG. 19

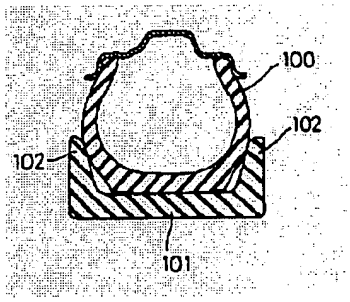

FIG. 20

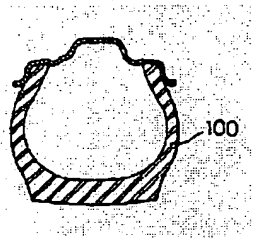

FIG. 21

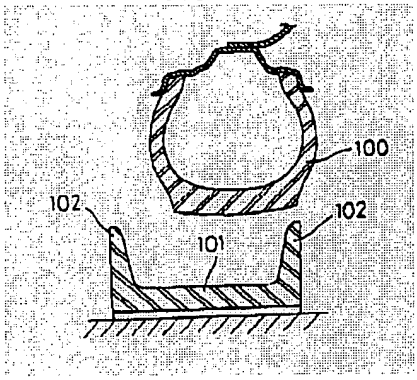

FIG. 23

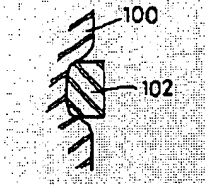

FIG. 22

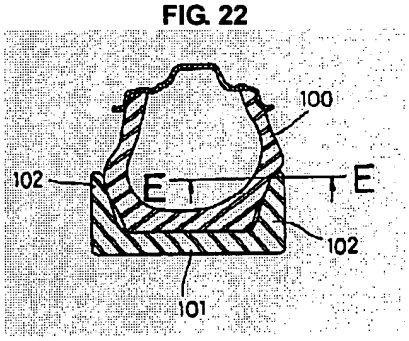

FIG. 24